SP 222 Homework Chapter 31 Due APR 2000 Name _____

1* • A 200-turn coil has an area of 4 cm^2 and rotates in a magnetic field of 0.5 T. (*a*) What frequency will generate a maximum emf of 10 V? (*b*) If the coil rotates at 60 Hz, what is the maximum emf?

6 • If the rms voltage in an ac circuit is doubled, the peak voltage is (*a*) increased by a factor of 2. (*b*) decreased by a factor of 2. (*c*) increased by a factor of $\sqrt{2}$. (*d*) decreased by a factor of $\sqrt{2}$. (*e*) not changed.

7 • A 100-W light bulb is plugged into a standard 120-V (rms) outlet. Find (*a*) I_{rms}, (*b*) I_{max}, and (*c*) the maximum power.

10 • If the frequency in the circuit shown in Figure 31-27 is doubled, the inductance of the inductor will (*a*) increase by a factor of 2. (*b*) not change. (*c*) decrease by a factor of 2. (*d*) increase by a factor of 4. (*e*) decrease by a factor of 4.

Figure 31-27

11 • If the frequency in the circuit shown in Figure 31-27 is doubled, the inductive reactance of the inductor will (*a*) increase by a factor of 2. (*b*) not change. (*c*) decrease by a factor of 2. (*d*) increase by a factor of 4. (*e*) decrease by a factor of 4.

12 • If the frequency in the circuit in Figure 31-28 is doubled, the capacitive reactance of the circuit will (*a*) increase by a factor of 2. (*b*) not change. (*c*) decrease by a factor of 2. (*d*) increase by a factor of 4. (*e*) decrease by a factor of 4.

13* • In a circuit consisting of a generator and an inductor, are there any times when the inductor absorbs power from the generator? If so, when. Are there any times when the inductor supplies power to the generator? If so, when.

14 • In a circuit consisting of a generator and a capacitor, are there any times when the capacitor absorbs power from the generator? If so, when. Are there any times when the capacitor supplies power to the generator? If so, when.

17* • At what frequency would the reactance of a 10.0-μF capacitor equal that of a 1.0-mH inductor?

19 • An emf of 10.0 V maximum and frequency 20 Hz is applied to a 20-μF capacitor. Find (*a*) I_{max} and (*b*) I_{rms}.

21* • Draw the resultant phasor diagram for a series *RLC* circuit when $V_L < V_C$. Show on your diagram that the emf will lag the current by the phase angle δ given by

$$\tan \delta = \frac{V_C - V_L}{V_R}$$

22 •• Two ac voltage sources are connected in series with a resistor $R = 25\ \Omega$. One source is given by $V_1 = (5.0\text{ V}) \cos(\omega t - \alpha)$, and the other source is $V_2 = (5.0\text{ V}) \cos(\omega t + \alpha)$, with $\alpha = \pi/6$. (*a*) Find the current in *R* using a trigonometric identity for the sum of two cosines. (*b*) Use phasor diagrams to find the current in *R*. (*c*) Find the current in *R* if $\alpha = \pi/4$ and the amplitude of V_2 is increased from 5.0 V to 7.0 V.

25* • Show from the definitions of the henry and the farad that $1 / \sqrt{LC}$ has the unit s^{-1}.

27 •• An LC circuit has capacitance C_1 and inductance L_1. A second circuit has $C_2 = \frac{1}{2}C_1$ and $L_2 = 2L_1$, and a third circuit has $C_3 = 2C_1$ and $L_3 = \frac{1}{2}L_1$. (*a*) Show that each circuit oscillates with the same frequency. (*b*) In which circuit would the maximum current be greatest if the capacitor in each were charged to the same potential V?

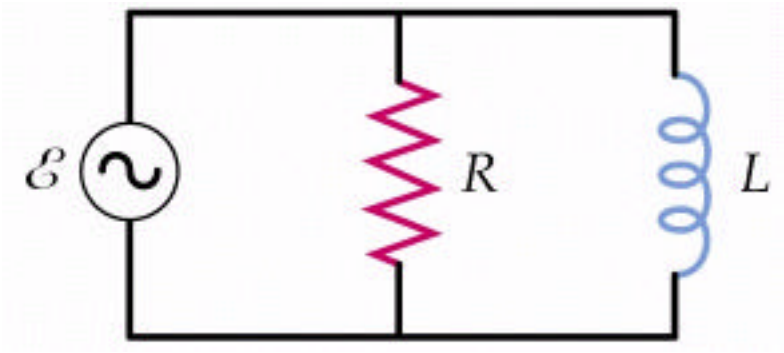
28 •• A 5-μF capacitor is charged to 30 V and is then connected across a 10-mH inductor. (*a*) How much energy is stored in the system? (*b*) What is the frequency of oscillation of the circuit? (*c*) What is the maximum current in the circuit?

29* • A coil can be considered to be a resistance and an inductance in series. Assume that R = 100 Ω and L = 0.4 H. The coil is connected across a 120-V-rms, 60-Hz line. Find (*a*) the power factor, (*b*) the rms current, and (*c*) the average power supplied.

30 •• A resistance *R* and a 1.4-H inductance are in series across a 60-Hz ac voltage. The rms voltage across the resistor is 30 V and the rms voltage across the inductor is 40 V rms. (*a*) What is the resistance *R*? (*b*) What is the ac rms input voltage?

33* •• A coil with resistance and inductance is connected to a 120-V-rms, 60-Hz line. The average power supplied to the coil is 60 W, and the rms current is 1.5 A. Find (*a*) the power factor, (*b*) the resistance of the coil, and (*c*) the inductance of the coil. (*d*) Does the current lag or lead the voltage? What is the phase angle δ?

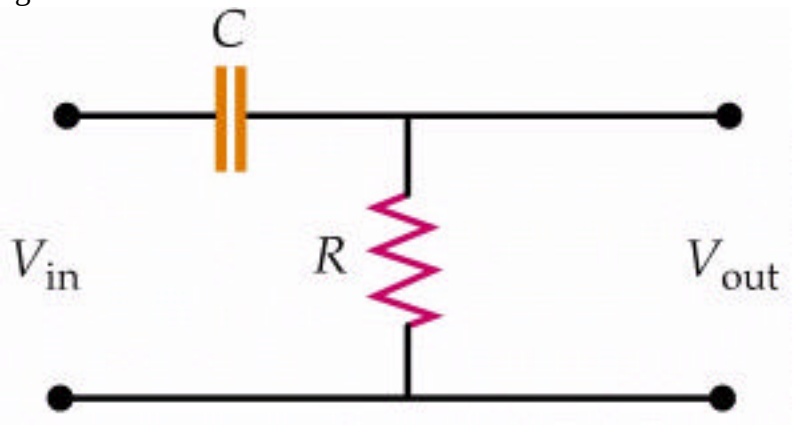
36 •• A resistor and an inductor are connected in parallel across an emf $E = E_{max} \cos\omega t$ as shown in Figure 31-30. Show that (*a*) the current in the resistor is $I_R = (E_{max}/R) \cos \omega t$, (*b*) the current in the inductor is $I_L = (E_{max}/X_L) \cos (\omega t - 90°)$, and (*c*) $I = I_R + I_L = I_{max} \cos (\omega t - \delta)$, where $\tan \delta = R/X_L$ and $I_{max} = E_{max}/Z$ with $Z^{-2} = R^{-2} + L^{-2}$.



40 •• The circuit shown in Figure 31-33 is called an *RC* high-pass filter because high input frequencies are transmitted with greater amplitude than low input frequencies. (*a*) If the input voltage is $V_{in} = V_0 \cos \omega t$, show that the output voltage is

$$V_{out} = \frac{V_0}{\sqrt{(1/\omega RC)^2 + 1}}$$

where V_{out} is the maximum value fo the output voltage.

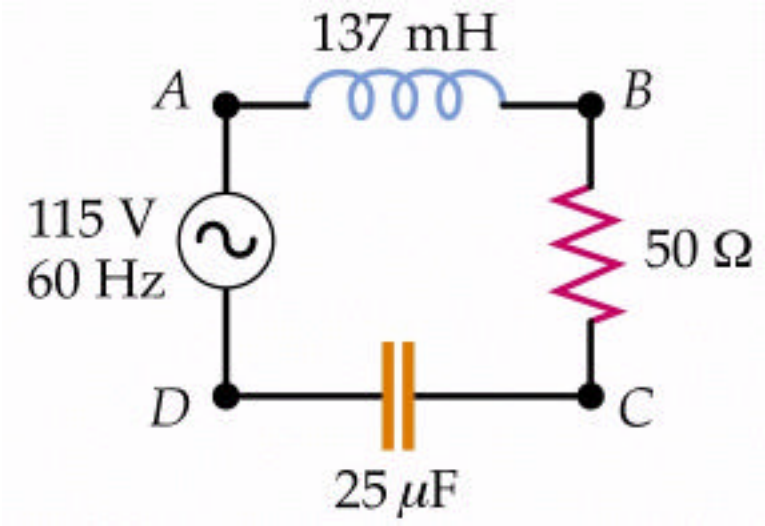


47 • True or false:
(*a*) An *RLC* circuit with a high *Q* factor has a narrow resonance curve.
(*b*) At resonance, the impedance of a series *RLC* circuit equals the resistance *R*.
(*c*) At resonance, the current and generator voltage are in phase.

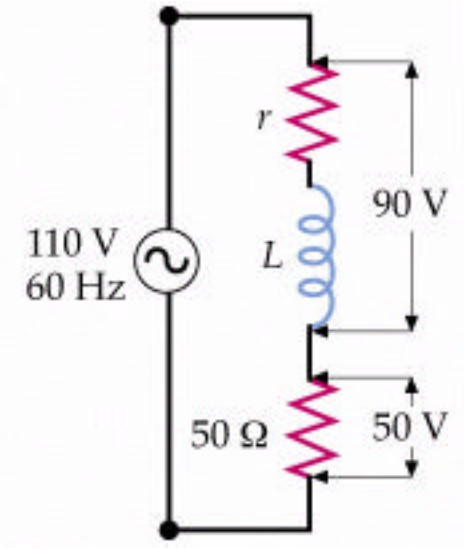
50 • What is the power factor for a circuit that has inductance and capacitance but no resistance?

54 •• Show that the formula $P_{av} = RE_{rms}^2/Z^2$ gives the correct result for a circuit containing only a generator and (*a*) a resistor, (*b*) a capacitor, and (*c*) an inductor.

64 •• In the circuit in Figure 31-37, the ac generator produces an rms voltage of 115 V when operated at 60 Hz. What is the rms voltage across points (*a*) *AB*, (*b*) *BC*, (*c*) *CD*, (*d*) *AC*, and (*e*) *BD*?



71 •• Given the circuit shown in Figure 31-38, (*a*) find the power loss in the inductor. (*b*) Find the resistance *r* of the inductor. (*c*) Find the inductance *L*.



100 • A transformer is used to change (*a*) capacitance. (*b*) frequency. (*c*) voltage. (*d*) power. (*e*) none of these.

101*• True or false: If a transformer increases the current, it must decrease the voltage.

102 •• An ideal transformer has N_1 turns on its primary and N_2 turns on its secondary. The power dissipated in a load resistance R connected across the secondary is P_2 when the primary voltage is V_1. The current in the primary windings is then (*a*) P_2/V_1. (*b*) $(N_1/N_2)(P_2/V_1)$. (*c*) $(N_2/N_1)(P_2/V_1)$. (*d*) $(N_2/N_1)^2(P_2/V_1)$.

104 • A transformer has 400 turns in the primary and 8 turns in the secondary. (*a*) Is this a step-up or step-down transformer? (*b*) If the primary is connected across 120 V rms, what is the open-circuit voltage across the secondary? (*c*) If the primary current is 0.1 A, what is the secondary current, assuming negligible magnetization current and no power loss?

106 • A transformer has 500 turns in its primary, which is connected to 120 V rms. Its secondary coil is tapped at three places to give outputs of 2.5, 7.5, and 9 V. How many turns are needed for each part of the secondary coil?

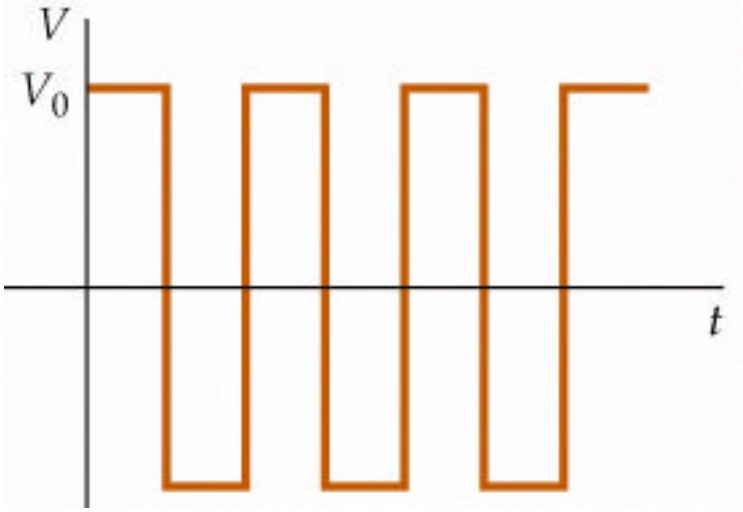
110 • True or false:

(*a*) Alternating current in a resistance dissipates no power because the current is negative as often as it is positive.

(*b*) At very high frequencies, a capacitor acts like a short circuit.

108 •• An audio oscillator (ac source) with an internal resistance of 2000 Ω and an open-circuit rms output voltage of 12 V is to be used to drive a loudspeaker with a resistance of 8 Ω. What should be the ratio of primary to secondary turns of a transformer so that maximum power is transferred to the speaker? Suppose a second identical speaker is connected in parallel with the first speaker. How much power is then supplied to the two speakers combined?

116 •• Figure 31-43 shows the voltage V versus time t for a "square-wave" voltage. If V_0 = 12 V, (*a*) what is the rms voltage of this waveform? (*b*) If this alternating waveform is rectified by eliminating the negative voltages so that only the positive voltages remain, what now is the rms voltage of the rectified waveform?



119 •• What are the average and rms values of current for the two current waveforms shown in Figure 31-45?